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CLASSIFICATION OF FISHES

ACCORDING TO

BRITISH MUSEUM (NATURAL HISTORY)

1962

ROYAL ONTARIO MUSEUM

Department of Ichthyology and Herpetology
University of Toronto
Toronto 5, Canada

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BRITISH MUSEUM (NATURAL HISTORY)

CLASSIFICATION OF FISHES

(Extinct groups underlined)

CLASS MARSIPOBRANCHII

- SUB-CLASS HETEROSTRACI. (Palaeaspidae, Cyathaspidae, Pteraspidae, Drepanaspidae)
- SUB-CLASS ANASPIDA.
- SUB-CLASS CEPHALASPIDA. (Cephalaspidae, Tremataspidae)
- SUB-CLASS CYCLOSTOMATA.
  - ORDER HYPEROARTIA.
    - Petromyzonidae.
  - ORDER HYPEROTRETA.
    - Myxinidae.
- SUB-CLASS CYCLIAE. (Palaeospondylidae)

CLASS PLACODERMI

- SUB-CLASS ACANTHODII. (Acanthoessidae, Diplacanthidae) Variously included in the class Selachii and so considered in this course.
- SUB-CLASS STEGOSELACHII. (Cratoselache etc.)
- SUB-CLASS RHENANIDA. (Gemuendina)
- SUB-CLASS ARTHRODIRA. (Coccosteidae etc.)
- SUB-CLASS ANTIARCHA. (Asterolepidae etc.)

CLASS SELACHII. (Ichthyodorulites, Cochliodontidae and Petalodontidae are composite groups).

Craniate vertebrates with jaws and with branchial arches supporting the gills. Nasal organs, paired blind sacs, with incompletely divided external apertures. Skin with denticles structurally similar to teeth; no dermal ossifications. Internal skeleton cartilaginous. Median and paired fins with horny rays, and with skeleton typically of a series of cartilaginous rods. Vertebral column consisting of the notochord and its sheath and neural and haemal arches; inter-muscular ribs; no supra-neural arches or pleural ribs; no air bladder.

SUB-CLASS PLEUROPTERYGII. (Cladoselachidae, Cladodontidae)
Paleozoic sharks with broad-based paired fins; the plevics without any fusion of the basalia, the pectorals scarcely more advanced in structure.

SUB-CLASS ACANTHODII. (Acanthoessidae, Diplacanthidae)
Paleozoic sharks with a strong spine at the anterior edge of each fin. As in the Pleuropterygii the paired fins were broad-based, and myxopterygia appear not to have been developed.

SUB-CLASS ICHTHYOTOMI. (Pleuracanthidae)
Paleozoic sharks in which the pectoral basalia form the segmented axis of the biserial fin like that of Ceratodus (lungfish); males with myxopterygia.

SUB-CLASS EUSELACHII.
Modern sharks and rays. Pectoral fin with metapterygium (fused basalia), and with propterygium and mesopterygium; formed by union of proximal segments of anterior radials; pelvic fins with pelvis and basipterygium; males with myxopterygia. Pterygoquadrate free from skull. Hyomandibular articulating with skull and supporting jaws. Gill clefts with separate external openings.

ORDER PLEUROTREMATA. (Sharks)
Pectoral fins free from head; gill openings lateral; hyomandibular with cartilaginous rays supporting the first half-gill. Two halves of the pectoral arch well separated above.

SUB-ORDER NOTIDANOIDEA
Chlamydoselachidae.
Hexanchidae.
Six or seven gill openings; a single dorsal fin above the anal. Rostrum simple.

SUB-ORDER GALEOIDEA.

Five gill openings. Two dorsal fins and an anal; no fin spines. Rostrum triradiate.

Odontaspidae.
Lamnidae.
Orectolobidae.
Scyliorhinidae.
Carcharinidae. (Carchariidae)
Isuridae

SUB-ORDER SQUALOIDEA.

Five or six gill-openings. Two dorsal fins, each typically preceded by a spine, but if these are wanting the anal fin is also absent. Rostrum simple.

Hybodontidae.
Heterodontidae. (Cestraciontidae)
Protospinacidae.
Pristiophoridae.
Squalidae.
Squatinidae.

ORDER HYPOTREMATA

Pectoral fins produced forward and joined to head; gill openings ventral. Hyomandibular purely suspensory.

SUB-ORDER NARCOBATOIDEA.

Large electric organs between pectoral fins and head. Suprascapulae united above vertebral column.

Torpedinidae.

SUB-ORDER BATOIDEA.

No large electric organs. Suprascapulae united to vertebral column.

Rhinobatidae.
Pristidae.
Raiidae.
Trygonidae.
Myliobatidae.
Mobulidae.

SUB-CLASS HOLOCEPHALI

Males with myxopterygia. Pterygoquadrate fused with skull. Lower jaw with one pair of tooth-plates, upper with two pairs. Hyoid arch complete, with pharyngohyal. Gill clefts opening into a chamber with one external opening.

Pyctodontidae.
Squaloraiidae.
Myriacanthidae.
Chimaeridae.

CLASS PISCES

The vertebral column differs from that of the selachians in having ribs that bound the abdominal cavity, which primitively meet in the tail region to form haemal spines, and in having a series of paired elements above the neural arches that meet above to bear an unpaired series of spines. This characteristic structure is well seen in the living Chondrostei and Dipneusti, but is modified by fusion and reduction in other fishes.

The dermal ossification on the body, where flexibility is a requirement, takes the form of juxtaposed rhombic bony plates or "ganoid scales" in the more generalized forms; in most recent fishes the scales are rounded and overlapping. Bony plates, including paired parietals and frontals are found on top of the skull, a parasphenoid below it, operculum and branchiostegals covering the gill-chamber and a series of four bones on each side overlying the pectoral arch and connecting it with the skull.

Toothed bones, the premaxillaries and maxillaries, form the upper border of the mouth, and the primary upper jaw lies within the mouth, is typically connected on each side with the ethmoid region of the skull, and is generally supported behind by the hyomandibular, which articulates with the skull. The septa between the gills are reduced, so that the gill laminae project as filaments; the gill-clefts lead into the gill-chamber, which has a single external opening. The air-bladder, originally a ventral diverticulum of the oesophagus, was perhaps first developed as an air-breathing organ. Several of the features that distinguish the Pisces from the Selachii, especially the premaxillaries and maxillaries, the bony skeleton, the air-bladder or lung, acquire additional importance because they are characteristic of all terrestrial vertebrates. The Batrachia or amphibia differ from the Pisces especially in the structure of the limbs, in having true internal nostrils, and in the modification of the hyomandibular into the stapes, but the crossopterygian fishes of the order Rhipidistia are very close to the Stegocephalia, which are the most primitive four-footed vertebrates.

The class Pisces, even as here restricted, is the largest of all the vertebrate classes, including some 20,000 living species. Moreover, within it is found a greater diversity of structure than in any other class of vertebrates. It has been distinct from the Selachii from Silurian times, and there is no connecting link between them.

SUB-CLASS PALAEOPTERYGII

Scales, when ganoid, formed of parallel layers of ganoine near the surface, and of bone within, separated by a layer of cosmine. Dorsal and anal fins with the dermal rays more numerous than their skeletal supports (except the dorsal of *Polypterus*), which typically form a regular series, with the radial segments well developed. Pectoral fin with one or more anterior radials articulating with the pectoral arch, the rest with a metapterygium; pelvic with a well-developed series of radials, and often with the posterior basals free, not incorporated in the pelvis. Skull with few cartilage bones, lateral ethmoids, and an unpaired sphenoid in the orbital region, a basioccipital and paired opisthotics being the usual ossifications. Maxillary firmly attached to ectopterygoid. Lower jaw without splenial or other bones below the dentary. No interoperculum and no symplectic. Clavicles present (except in the Belonorhynchii).

ORDER ARCHISTIA

Body usually covered with ganoid scales. Caudal fin heterocercal. Head covered with bones; preoperculum large, extending forward over cheek. Snout short; mouth normally formed, with fixed premaxillaries, and with palagine attached to ethmoid region of skull. Clavicles present. Vertebral column acentrous.

Palaeonoscidae
Platysomidae
Dorypteridae
Bobasatraniidae
Catopteridae
Pholidopleuridae
Perleididae

ORDER CLADISTIA

Scales, head skeleton, pectoral arch, etc., nearly as in the Palaeoniscidae; anal fin with rays more numerous than radials, and pelvics with well developed radials; but other fins more specialized, the pectorals with one large radial articulating with the pectoral arch and numerous small ones articulating with a plate developed between them and the metapterygium; caudal abbreviate heterocercal (as in Amia); dorsal long, with each ray supported by its own basal, and all but the posterior ones spaced forming strong spines. No branchiostegals but a pair of large gular plates. Vertebral column with bony centra.

Polypteridae
Calamoichthidae

ORDER CHONDROSTEI
Body naked, or with vestigial scales, sometimes with series of bony scutes. Caudal fin heterocercal. Snout prominent; jaws toothless; premaxillaries absent; pterygoquadrates meeting below skull, protractile. No preoperculum. Clavicles present. Vertebral column acentrous.

- Chondrosteidae
- Acipenseridae
- Polyodontidae

ORDER BELONORHYNCHII
Body with four series of bony scutes. Caudal fin symmetrical. Snout and lower jaw very long; premaxillaries present, and palato-quadrates as in the Archistia. No clavicles. Vertebral column acentrous. The Triassic Saurichthyidae are pike-like fishes, whose structure has recently been elucidated by Stensio (1925).

- Saurichthyidae (Belonorhynchidae)

SUB-CLASS NEOPTERYGII

Scales, when ganoid, of parallel layers of ganoine outside and of bone within, without a cosmine layer. Dorsal and anal rays equal in number to their skeletal supports, each articulating with its own radial, which is small, or fused with the basal. Caudal fin abbreviate heterocercal or homocercal. Pectoral fins with all or some of the radials articulating with the pectoral arch; pelvic fins with the radials reduced or absent, the rays articulating with the pelvic bone. Typically a symplectic and an interoperculum. Skull typically with orbitosphenoids and alisphenoids and with five otic bones on each side. No clavicles.

ORDER PROTOSPONDYLI

Caudal fin abbreviate heterocercal with all the hypurals supported by the upturned end of the vertebral column. Centra absent, or variously developed. Premaxillaries fixed, firmly attached to frontals, pierced for passage of olfactory nerves. Maxillaries movable, anteriorly articulating with ethmoid region of skull. Lower jaw with dentary, angular and supraangular on the outside with large dentigerous prearticular on the inside, and with two articular bones for the quadrate and one for the symplectic, which articulates with it above and outside the quadrate. Hyomandibular firmly attached to quadrate, and preoperculum to both. One coracoid bone, or none; mesocoracoid bridge cartilaginous; one or more pectoral radials on metapterygium. Scales often ganoid.

Semionotidae
Macrosemiidae
Eugnathidae
Amiidae
Pachycormidae
Aspidorhynchidae
Pycnodontidae, etc.

ORDER GINGLYMODI

Distinguished from the preceding by the structure of the jaws, suspensorium and opercles. Snout and lower jaw long; maxillary segmented, the first one or two segments attached to premaxillary, the rest to the ectopterygoid; metapterygoids articulating with transverse facets on wings of parasphenoid; hyoid arch free from pterygo-quadrate; preoperculum small, its anterior end articulating with a condyle or quadrate; interoperculum large, fixed, connecting hyomandibular with preoperculum. Vertebrae solid, opisthocoelous.

Lepidosteidae

ORDER HALECOSTOMI

Differ from the Protospondyli in that the premaxillaries are small and loosely attached; the maxillary has a convex oval border and bears two supplemental bones, and the lower jaw has no supraangular. Vertebral centra annular or biconcave.

Pholidophoridae
Oligopleuridae

ORDER ISOSPONDYLI

Caudal fin homocercal, i.e., the upturned end of the vertebral column is short, with not more than two or three centra, and the upper hypurals are supported by paired bones - uroneurals - that appear to be the enlarged neural arches of posterior vertebrae that have aborted. Fins without spinous rays; pelvics generally abdominal in position. Air-bladder with an open duct. Maxillaries generally forming part of upper border of mouth. Lower jaw without supraangular and without or with small prearticular. An endochondral supraoccipital. Coraco-scapular cartilage typically with three ossifications, including a mesocoracoid; pectoral radials articulating direct with pectoral arch, the lowest perhaps representing the metapterygium. Vertebrae biconcave. Scales not ganoid, but cycloid. ie. Amphicoelus.

SUB-ORDER CLUPEIODEA

Leptolepidae
Elopidae
Albulidae
Saurodontidae
Alepocephalidae
Clupeidae
Ctenothrissidae
Chanidae
Kneriidae
Phractolaemidae
Cromeriidae

SUB-ORDER SALMONOIDEA

Salmonidae
Opisthoproctidae
Argentinidae
Microstomidae
Osmeridae
Retropinnatidae
Salangidae
Galaxiidae
Haplochitonidae

SUB-ORDER STOMIATOIDEA
- Gonostomatidae
- Sternoptychiidae
- Enchodontidae
- Astronesthidae
- Chauliodontidae
- Stomiatidae
- Malacosteidae

SUB-ORDER OSTEOGLOSSOIDEA
- Osteoglossidae
- Pantodontidae

SUB-ORDER NOTOPTEROIDEA
- Hyodontidae
- Notopteridae

SUB-ORDER MORMYROIDEA
- Mormyridae
- Gymnarchidae

SUB-ORDER GONORHYNCHOIDEA
- Gonorhynchidae

ORDER HAPLOMI

Soft-rayed fishes with abdominal pelvic fins, with the maxillary entering the gape, and with an open duct to the air-bladder. Vertebral column with separate parapophyses inserted in pits in the centra, orbitosphenoid, and no mesocoracoid; mesethmoid represented by a pair of large dermal bones.
- Esocidae
- Umbridae
- Dalliidae

ORDER INIOMI

Soft-rayed fishes with pelvic fins abdominal or thoracic and pelvic bones free from the cleithra, air-bladder usually absent, when present with an open duct, mouth bordered above by the premaxillaries; pectoral arch attached to the skull by a forked post-temporal; no mesocoracoid; vertebral centra co-ossified with the arches; adipose fin generally present. A large and varied group of marine fishes.

SUB-ORDER MYCTOPHOIDEA

Pectoral fins lateral, pelvics below or behind them. Palatine normal, articulating with the vomer. Cleithrum attached to lower end of supracleithrum.

Aulopidae
Synodontidae
Sudidae
Myctophidae (Scopelidae)

SUB-ORDER ALEPIDOSAUROIDEA

Pectoral fins low, pelvics far behind them. Palatine large, firmly fixed to frontals and to ethmoid region of skull. Cleithrum attached near upper end of supracleithrum, which runs downwards and backwards and bears the post-cleithrum at its lower end. Fishes with a large mouth, with strong canines on the palatines and in the lower jaw, and with the premaxillaries and maxillaries slender and united posteriorly.

Scopelarchidae (Cetomimidae?)
Alepidosauridae
Omosudidae

SUB-ORDER ATELEOPOIDEA

Pectorals lateral, pelvics in advance of them, wide apart, each of a single ray, inserted at the sides of a cartilaginous pelvis which bears a pair of long posterior processes as in *Aulopus*. Skull in great part cartilaginous. Elongate, naked fishes, with short dorsal fin just behind the head, long anal joined to the small caudal, and small subterminal mouth.

Ateleopidae

ORDER GIGANTUROIDEA

Naked soft-rayed fishes without air-bladder, without pelvic fins and with long many-rayed pectorals high up, above and behind the small gill-openings. Mouth wide, bordered above by the long premaxillaries, which are united on the inside to the ectopterygoids; no maxillaries and no palatines. Gills small, widely separated from those of the other side, the lower parts of the gill-arches being undeveloped. Pectoral arch free from skull; no post-temporal and no supra-cleithrum; pectoral radials and coracoid ossifications thin plates.

Giganturidae

ORDER LYOMERI

Naked soft-rayed fishes with long slender tail, long dorsal and anal fins, no caudal, small pectorals and no pelvics. Gill-openings small. Mouth very large, bordered above by a pair of slender bones that meet in front and behind are attached within the quadrates, connected

with head by loose skin; no palatine or pterygoid bones; hyomandibular-quadrate long, oblique; gills and pectoral arch far behind head, with reduced skeleton; skull with much cartilage and thin membrane bones; Parietals meeting in front of supraoccipital. No ribs. No air-bladder.

Saccopharyngidae
Eurypharyngidae

ORDER OSTARIOPHYSI

Closely related to the Isospondyli; but distinguished by a communication between the air-bladder and the internal ear through a chain of ossicles, which are modified elements of the four anterior vertebrae. An orbitosphenoid; generally a mesocaracoid.

SUB-ORDER CYPRINOIDEA

Body generally normally scaled.

Characinidae
Gastropelecidae
Xiphostomatidae
Anostomidae
Hemiodontidae
Citharinidae
Rhamphichthyidae
Sternarchidae
Gymnotidae
Electrophoridae
Catostomidae
Cyprinidae
Cobitidae
Homalopteridae

SUB-ORDER SILUROIDEA

The siluroids or catfishes have the body naked or covered with bony plates. Mouth toothed and non-protractile. Without parietals, opisthotic, symplectic or suboperculum. First vertebra a disc rigidly united to basioccipital and to the second, third and fourth vertebrae which are ankylosed to form a complex, to which the fifth is rigidly attached. Parapophyses ankylosed to the centra. The mouth is generally furnished with barbels.

Diplomystidae
Ariidae
Doradidae
Plotosidae
Siluridae
Bagridae
Areuridae
Amblycepidae
Sisoridae
Amphiliidae
Chacidae
Schilbeidae
Pangasiidae
Mochocidae (Synodontidae)
Malopteruridae
Pimelodidae
Helogenidae
Hypophthalmidae
Trichomycteridae (Pygidiidae)
Bunocephalidae
Callichthyidae
Loricariidae

ORDER APODES

Soft-rayed fishes with an open duct to the air-bladder and with the pelvic fins, when present, abdominal. Body elongate; gill-openings small; dorsal and anal contiguous to or continuous with the caudal; pelvic fins usually absent.

Urenchelidae
Anguillidae
Simenchelidae
Xenocongridae
Derichthyidae
Myrocongridae
Muraenidae
Heterenchelidae
Moringuidae
Serrivomeridae
Nemichthyidae
Cyemidae
Muraenesocidae
Neenchelidae
Nettastomidae
Nessorhamphidae
Congridae
Echelidae
Ophichthyidae
Ilyophidae
Dysommidae
Synaphobranchidae

ORDER HETEROMI

Air-bladder without duct (physoclystous), but ventral colour primitive, with the parapophyses separate elements. Skull elongate, with parietals meeting above supraoccipital and parasphenoid joining sphenotic; basisphenoid, alisphenoid, orbitosphenoid and opisthotic absent; post-temporal simple or ligamentous.

Halosauridae
Lipogenyidae
Notacanthidae

ORDER SYNENTOGNATHI

Soft-rayed physoclists with abdominal, six-rayed, pelvic fins, and with the lower pharyngeals united to form a single bone. Premaxillaries non-protractile and maxillaries entering gape to a greater or less extent; lower jaw with laminar prearticular. Parietals, if present, very small, separated by supraoccipital; no orbitosphenoid and no opisthotic; epiotic and pterotic produced back into a lamina, to which the post-temporal is attached; supra-cleithrum reduced; pectoral radials short, rigidly attached.

SUB-ORDER SCOMBRESOCOIDEA

Scales small; jaws produced. Third upper pharyngeals moderately enlarged and separate. Lower pharyngeals triangular or long and narrow. Cleithrum connected with basioccipital by a strong ligament.

Belonidae
Scombresocidae

SUB-ORDER EXOCOETOIDEA

Scales rather large; mouth small. Third upper pharyngeals much enlarged, together forming a somewhat convex ovoid plate that opposes the concave upper surface of the broad lower pharyngeal. Cleithrum articulates directly with basioccipital.

Hemirhamphidae
Exocoetidae

ORDER MICROCYPRINI

Soft-rayed physoclists with abdominal pelvic fins, without lateral line, and with terminal mouth bordered above by the premaxillaries. Lower pharyngeals separate, or if united, with persistent median suture. Parietals separated by supra-occipital; mesethmoid flat; nasals well separated; no orbitosphenoid.

Amblyopsidae
Cyprinodontidae (Cyprinodontinae, Fundulinae, Orestiinae, Jenynsiinae, Anablepinae, Poeciliinae)
Phallostethidae

ORDER SALMOPERCAE

Physoclists. Dorsal and anal fins preceded by one to four spines. Sub-abdominal pelvic fins, each composed of a rudimentary spine and seven or eight soft rays. Pelvic girdle bones connected with post-cleithra. Premaxillaries forming upper border of mouth. No orbitosphenoid.

Percopsidae
Aphredoderidae

ORDER SOLENICHTHES

Physoclists with abdominal pelvic fins without spine, and with the mouth at the end of a long tube-like snout. Parietals absent; pterotic extending downward to basioccipital; no opisthotic. A spinous dorsal fin sometimes present.

Aulostomatidae
Fistulariidae
Macrorhamphosidae
Centriscidae (Amphisilidae)
Solenostomidae
Syngnathidae

ORDER ANACANTHINI

Soft-rayed fishes with the pelvic fins often many-rayed and thoracic or jugular in position. Pelvic bones not directly attached to the cleithra. Caudal fin, when present, formed mainly of dorsal and anal rays, the homocercal fin being reduced. Air-bladder without duct. Mouth bordered above by the protractile premaxillaries. No orbitosphenoid; opisthotic large, extending downwards to basioccipital.

Macruridae
Merlucciidae
Gadidae
Muraenolepidae

ORDER ALLOTRIOGNATHI

Soft-rayed fishes (the first one or two rays of the dorsal sometimes spinous) with protractile maxillaries, each of an outer blade and an inner posterior process that is connected with its fellow and underlies the similar process of the premaxillary. Pectoral with horizontal base, pelvic fins, when present, below or a little behind the pectorals, often many-rayed; pelvic bones erect, triangular, inserted between hypocoracoids and sometimes articulated to them. An orbitosphenoid, no opisthotic.

Lamprididae
Veliferidae
Trachypteridae
Lophotidae
Stylophoridae

ORDER BERYCOMORPHI

Physoclists with the anterior rays of the vertical fins spinous, with pelvic fins thoracic or subabdominal, often many-rayed and with caudal that has generally 19 principal rays, 17 branched. Mouth bordered above by the protractile premaxillaries; one or two supplemental maxillaries. Skull with orbitosphenoid, alisphenoids and Y-shaped "basisphenoid"; opisthotic well-developed; parietals separated by supra-occipital; a thin-walled otic bulla. Hyo-palatine and opercular bones normally developed. Vertebral centra solid and co-ossified with arches. Post-temporal forked, attached to epiotic and opisthotic; no mesocoracoid; pectoral radials hour-glass shaped, four in number.

Polymixiidae
Berycidae
Berycopsidae
Diretmidae
Trachichthyidae
Caristiidae
Monocentridae
Anomalopidae
Holocentridae
Stephanoberycidae
Melamphaidae
Rondeletiidae

ORDER ZEOMORPHI

Distinguished from the Berycomorphi by certain features of specialization. A spinous dorsal; anal fin preceded by one to four spines which form a more or less distinct fin; caudal with 12 or 13 principal rays; pelvics each of a spine and five to nine branched rays, thoracic. No orbitosphenoid. Post-temporal simple, rigidly united to skull, cleithrum ending above in a pointed projection just behind post-temporal. Pelvic bones directly attached to cleithra. First vertebra very firmly united to skull.

Zeidae
Caproidae

ORDER PERCOMORPHI

Allied to the Berycomorphi, but without an orbitosphenoid, with not more than one supplemental maxillary; pelvic fins with not more than six rays, caudal typically with 17 principal rays, 15 branched, never with more. Pectoral arch attached to skull by a more or less distinctly forked post-temporal, and pelvic bones typically attached to cleithra, although in some groups this attachment is lost.

SUB-ORDER PERCOIDEA

Pelvic fins thoracic or jugular, typically of a spine and five soft rays; pelvic bones directly attached to cleithra; without special features characterizing remaining sub-orders.

Serranidae
Pseudoplesiopidae
Kuhliidae
Centrarchidae
Priacanthidae
Chilodopteridae
Pomatomidae
Rhachicentridae
Carangidae
Menidae
Bramidae
Coryphaenidae
Centropomidae
Arripididae
Erythrichthyidae
Lutianidae
Nemipteridae
Lobotidae
Liognathidae
Pomadasidae (Pristipomatidae)
Sciaenidae
Mullidae
Lethrinidae

Percidae
Latilidae
Sillaginidae
Lactariidae
Bathyclupeidae
Labracoglossidae
Cepolidae
Cirrhitidae
Chironemidae
Aplodactylidae
Cheilodactylidae
Latrididae
Ditremidae (Embiotocidae)
Pomacentridae
Labridae
Odacidae
Scaridae
Gadopsidae
Trichodontidae
Ammodytidae
Champsodontidae
Opisthognathidae

Sparidae
Maenidae
Monodactylidae
Pempheridae
Toxotidae
Scorpididae
Kyphosidae
Girellidae
Ephippidae
Drepanidae
Scatophagidae
Chaetodontidae
Enoplosidae
Histiopteridae
Pristolepidae
Nandidae
Oplegnathidae
Cichlidae
Bathymasteridae
Pinguipedidae
Cheimarrhichthyidae
Trachinidae
Percophiidae
Bembropsidae
Hemerocoetidae
Trichonotidae
Creediidae
Limnichthyidae
Leptoscopidae
Uranoscopidae
Chiasmodontidae
Bovichthyidae
Nototheniidae
Bathydraconidae
Chaenichthyidae

SUB-ORDER TEUTHIDOIDEA

Hyomandibular attached to suborbitals, with inner shelf articulating with prootic.

Zanclidae
Teuthididae (Acanthuridae)

SUB-ORDER SIGANOIDEA

Maxillary firmly attached to premaxillary, articulating with a prepalatine bone; pelvics of two spines and three soft rays between them.

Siganidae

SUB-ORDER KURTOIDEA

Ribs expanded juxtaposed rings enclosing the air-bladder.

Kurtidae

SUB-ORDER TRICHIUROIDEA

Premaxillaries fixed, beak-like; hypurals not covered by bases of fin rays.

Gempylidae
Trichiuridae

SUB-ORDER SCOMBROIDEA

Premaxillaries fixed; caudal widely forked, the bases of the rays of the upper and lower lobes meeting, concealing the hypurals.

- Scombridae
- Luvaridae
- *Palaeorhynchidae*
- Histiophoridae
- *Blochiidae*
- Xiphiidae
- *Xiphiorhynchidae*

SUB-ORDER GOBIOIDEA

Opisthotic enlarged, reaching basioccipital; no parietals.

- Eleotridae
- Gobiidae
- Vitreolidae (Psammichthyidae)

SUB-ORDER CALLIONYMOIDEA

No entopterygoid or metapterygoid; supracleithrum slender, directed outwards; pectoral radials large, laminar.

- Callionymidae
- Draconettidae

SUB-ORDER BLENNIOIDEA

Pelvics jugular, with rays reduced in number; parasphenoid with ascending wings meeting alisphenoids or frontals; dorsal and anal rays corresponding to vertebrae, each basal attached to a neural or haemal spine.

- Blenniidae
- Anarrhichadidae
- Congrogadidae
- Notograptidae
- Clinidae
- Dactyloscopidae
- Xiphiodontidae
- Stichaeidae
- Pholididae
- Lumpenidae
- Microdesmidae
- Ptilichthyidae
- Zoarcidae
- Scytalinidae
- Rhodichthyidae

SUB-ORDER OPHIDIOIDEA

Pelvics jugular or mental, of one or two filamentous rays; fins without spines; parasphenoid meeting frontals; dorsal and anal rays more numerous than vertebrae.

- Brotulidae
- Ophidiidae
- Fierasferidae

SUB-ORDER STROMATEOIDEA

Oesophagus expanded to form a muscular sac with internal papillae and often with teeth.

- Nomeidae
- Stromateidae
- Tetragonuridae

SUB-ORDER ANABANTOIDEA

An air-breathing chamber above the gills, containing a labyrinthic organ.

- Anabantidae
- Luciocephalidae

SUB-ORDER MUGILOIDEA

Pelvics subabdominal, of a spinous and five branched rays; pelvic bones not attached to cleithra; pectorals normal.

- Sphyraenidae
- Mugilidae
- Atherinidae

SUB-ORDER POLYNEMOIDEA

Pelvics subabdominal, of a spine and five branched rays; pelvic bones not attached to cleithra; pectoral with a detached lower part of free filamentous rays.

- Polynemidae

SUB-ORDER OPHIOCEPHALOIDEA

An air-breathing chamber above the gills; no labyrinth organ; no spinous fin rays; pelvics subabdominal, six-rayed.

- Ophiocephalidae

ORDER SCLEROPAREI

Allied to the Percomorphi, but with the second suborbital produced across the cheek, typically articulating with the preoperculum. The recognition of this large and varied group as an order is convenient.

SUB-ORDER SCORPAENOIDEA

Mesethmoid ossified; nasals paired; an opisthotic. Second suborbital rigidly attached to first. Post-temporal not enlarged. Anterior vertebrae free, normal. Pelvic bones directly attached to cleithra.

- Scorpaenidae
- Triglidae
- Caracanthidae
- Hoplichthyidae
- Congiopodidae
- Cottidae

Aploactinidae
Synanciidae
Pataecidae
Hexagrammidae
Anoplopomatidae
Platycephalidae
Cottunculidae
Psychrolutidae
Comephoridae
Agonidae
Cyclopteridae
Liparidae

SUB-ORDER GASTROSTEOIDEA

Pelvic bones not attached to cleithra.

Gastrosteidae
Aulorhynchidae

SUB-ORDER DACTYLOPTEROIDEA

Mesethmoid unossified; nasals united to form a median plate; no opisthotic. Second suborbital small, movably articulated with first and with preoperculum. Post-temporal a very large plate. First three vertebrae long, rigidly united. Pelvic bones attached to cleithra. Pectoral fin very large.

Dactylopteridae (Cephalacanthidae)

ORDER HYPOSTOMIDES

Body enclosed in a broad bony box, tail in bony rings; a rostrum formed by the coalesced nasals; behind it a bony cavity bounded by the nasals and preorbitals, open below and containing the mouth, which is small, toothless, and protractile downwards; maxillaries protractile, produced forwards above premaxillaries, meeting in front and connected by ligament to roof of bony cavity; premaxillaries retractile within maxillaries. No air-bladder.

Pegasidae

ORDER HETEROSOMATA

Allied to the Percomorphi, but asymmetrical, with both eyes on one side. Strongly compressed fishes with long many-rayed dorsal fins.

Psettodidae
Bothidae
Pleuronectidae
Soleidae
Cynoglossidae

ORDER DISCOCEPHALI

Allied to the Percomorphi but with the spinous dorsal fin transformed into a flat, oval, transversely laminated, adhesive disc, which extends forward on the upper surface of the head. The small lateral expansion of the radials found in the spinous dorsal of most percoids has developed into large overlapping laminae.

- Echeneidae
- Opisthomyzonidae

ORDER PLECTOGNATHI

Allied to Percomorphi. Parietals absent or co-ossified with epiotics, which are separated by supraoccipital; hyomandibular and palatine rigidly united to skull; post-temporal short, simple, completely united by suture to pterotic; pelvic bones, when present, long, united by suture or co-ossified. Gill openings small.

SUB-ORDER BALISTOIDEA

Supra-cleithrum vertical. Pectoral radials small, movable. Neural spines singular.

- Triacanthidae
- Balistidae
- Monacanthidae
- Triodontidae
- Ostracionidae

SUB-ORDER TETRODONTOIDEA

Supra-cleithrum oblique or horizontal. Pectoral radials enlarged, fixed. Neural spines of anterior vertebrae double. Spinous dorsal, pelvics, and pelvic fins wanting.

- Tetrodontidae
- Diodontidae
- Molidae

ORDER MALACICHTHYES

Physoclists with the mouth bordered above by the non-protractile premaxillaries, without spinous fin-rays, and with pelvic fins, when present, abdominal and five-rayed. Skeleton weakly ossified. Position uncertain but may be specialized and degenerate percoids.

- Icosteidae

ORDER XENOPTERYGII

Naked fishes allied to Percomorphi. Head broad, snout pointed, teeth conical or incisor like, body depressed.

- Gobiesocidae

ORDER HAPLODOCI

Distinguished from the Percomorphi by peculiarities of the skull and of the pectoral arch. First vertebra rigidly attached to skull; which is broad and flat; epiotics and opisthotics absent; post-temporal short, simple, united to skull by a suture; hypercoracoid and hypocoracoid small; pectoral radials elongate, four or five in number, the lowest much expanded distally. No ribs, but epipleurals present. Gill openings restricted.

Batrachoididae

ORDER PEDICULATI

Distinguished by having the spinous dorsal fin formed of a few flexible rays, the first of which is the illicium, and is placed on the head. The illicium generally ends in a flap, tassel, or bulb and is used as a line and bait. The pectoral arch is the same as in the Haplodoci. There are, however, only 2 or 3 radials. There are no ribs and no epipleurals. The gill openings are small.

SUB-ORDER LOPHIOIDEA

These are naked fishes with a large, depressed head and a wide mouth. The jaws are equipped with depressible, cardiform teeth. The lower pharyngeals are well developed and toothed.

Lophiidae

SUB-ORDER ANTENNARIOIDEA

Includes anglers in which the mouth is small or of moderate size rather than those of a large mouth which are placed in the Lophioidea. They resemble the Lophioids in having pelvic fins and toothed lower pharyngeals but differ in the structure of the vertebral column and skull, particularly in having the frontal bones separated for a greater part of their length.

Antennariidae
Brachionichthyidae
Chaunacidae
Ogcocephalidae (Malthidae)

SUB-ORDER CERATIOIDEA

Distinguished by the absence of pelvic fins, by the reduced toothless lower pharyngeals, and by having the males dwarfed and parasitic on the females. These are oceanic fishes, inhabiting the middle depths, from about 500 to 2,000 metres below the surface; as there is little or no light in this region the majority are uniformly blackish in color, and their bait, or terminal expansion of the illicium, is a luminous bulb.

Melanocetidae
Diceratiidae
Himantolophidae
Oneirodidae
Laevoceratiidae
Gigantactinidae
Neoceratiidae
Ceratiidae
Caulophrynidae
Photocorynidae
Linophrynidae

ORDER OPISTHOMI

Elongate fishes allied to the Percomorphi. Body covered with small scales; dorsal and anal fins long, many-rayed, contiguous to or confluent with the small caudal; dorsal preceded by a series of isolated spines, except in *Chaudhurea*; pectorals well developed; pelvics absent. Mouth terminal, with villiform teeth. Posterior nostril in front of eye, anterior tubular, at the end of a fleshy tentacle at the end of snout. Gill-openings restricted from above, the operculum without free edge.

Mastacembelidae

ORDER SYMBRANCHII

Eel-shaped fishes, with the caudal fin very small, 8-10 rayed and continuous with the dorsal and anal, which are rayless folds of the skin; no pectoral fins; pelvics, if present jugular. No air-bladder. Gill-openings confluent below but restricted from above, typically appearing as a transverse ventral slit.

SUB-ORDER ALABETOIDEA

Minute two-rayed pelvic fins are present, just behind the gill-opening, and the dorsal and anal fins are well-developed. The mouth is small, with a series of blunt compressed teeth in the jaws. The skull is broad and depressed, with the parasphenoid and frontals separated by an interspace and the parietals not meeting above the supraoccipital. The premaxillaries have strong posterior prodicals.

Alabetidae

SUB-ORDER SYMBRANCHOIDEA

In the symbranchoid eels, pelvic fins are absent and the dorsal and anal are vestigial. The mouth is moderately large with acute teeth. The skull is elongate, with the parasphenoid united to each of the frontals by a long suture, and with the parietals meeting above the supraoccipital. The premaxillaries have no pedicel.

Symbranchidae

SUB-CLASS CROSSOPTERYGII

Scales, when ganoid, with a single superficial layer of ganoine above the cosmine layer, which has a very regular structure. Pectoral fins lobate, typically with all the radials articulating with the segmented metapterygium, and none directly with the pectoral arch. Pelvic fins similar. Skull with a few cartilage bones, generally differing from the skull of the Sub-Class Paleopterygii in having an unpaired sphenoid postorbital. No branchiostegals, but often a pair of large gular-plates. Clavicles present.

ORDER RHIPIDISTIA

Premaxillaries and maxillaries present; palato-quadrate not fused with skull; hyomandibular well developed; pectoral fins obtusely or acutely lobate, articulating with pectoral arch by proximal segments of the matapterygium.

- Holoptychiidae
- Rhizodontidae (Megalichthyidae)
- Osteolepidae (Rhombodipteridae)

ORDER ACTINISTIA

Highly specialized fishes apparently derived from the Rhipidistia (Stensio, 1921). Hyomandibular very small; palato-quadrate articulating with otic region of skull. Paired fins with short rounded lobes, the pectorals with a few radiating radials that may articulate direct with the pectoral arch.

- Coelacanthidae

ORDER DIPNEUSTI (DIPNOI)

Premaxillaries and maxillaries absent. Palato-quadrate fused with skull. Teeth forming a pair of plates on the palate, and one on the inside (prearticular) of each lower jaw. Paired fins acutely lobate, hyomandibular vestigial.

- Dipteridae
- Phaneropleuridae
- Ctenodontidae
- Uronemidae
- Lepidosirenidae
- Ceratodontidae

A PHYLOGENETIC TREE OF THE MAJOR GROUPS OF BONY FISHES

(as given in this outline)
(After Norman, A History of Fishes, fig. 135, p. 375)